DOCUMENT RESUME

ED 390 676 SE 057 307

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TITLE Analysis of Eighth Graders' Performance On Standardized Mathematics Tests.
PUB DATE 5 Nov 94
NOTE 17p.; Paper presented at the Annual Meeting of the Midsouth Educational Research Association (Nashville, TN, November 5, 1994).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Ethnicity; Grade 8; Junior High Schools; *Mathematics Achievement; Multiple Regression Analysis; *Racial Differences; *Sex Differences; *Socioeconomic Status; Standardized Tests; *Student Attitudes
IDENTIFIERS *National Education Longitudinal Study 1988

ABSTRACT

The main objective of this study was to show whether eighth graders' performance on standardized mathematics tests could be predicted from a variety of variables. These predictors included the students' race/ethnicity, gender, attitudes toward mathematics, students' time spent on homework, whether parents helped with homework assignments, students' perceptions of their teachers, reported school climate, and the availability of remedial mathematics. Data came from the base year of the National Education Longitudinal Study of Eighth Graders. A sample of 9,000 students was selected from the data set. Multiple regression analysis was used to analyze the data. As expected, the socioeconomic indicator (SES) was the best predictor of math performance. However, after controlling for the variation in SES and race/ethnicity, a number of other variables also contributed significantly to the variations in math performance. Among these were students' perceptions about mathematics, school climate, the availability of remédial mathematics, student/teacher relationship, gender, and the amount of time spent on homework. (Author)

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An Analysis of Eighth Graders' Performance On Standardized Mathematics Tests

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Presented at the Annual Meeting of the Midsouth Educational Research Association, Nashville, 1994.

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Abstract

The main objective of the study was to show whether eighth graders' performance on standardized mathematics tests could be predicted from a variety of variables. These predictors included the students' race/ethnicity, gender, attitudes toward mathematics, students' time spent on homework; whether parents helped with homework assignments; students' perceptions of their teachers, reported school climate; and the availability of remedial mathematics. Data came from the base year of the National Education Longitudinal Study of Eighth Graders. A sample of 9,000 students was selected from the data set. Multiple regression analysis was used to analyze the data. As expected, the socioeconomic indicator was the best predictor of math performance. However, after controlling for the variation in SES and race/ethnicity, a number of other variables also contributed significantly to the variations in math performance. Among these were students' mathematics perceptions, school climate, the availability of remedial mathematics, student/teacher relationship, gender, and the amount of time spent on homework.

Historically, the purposes of secondary school mathematics have been to provide students with opportunities to acquire mathematical knowledge, skills, and modes of thought needed for daily life and effective citizenship, to prepare students for occupations after graduation, and to prepare students for postsecondary education (NCTM, 1980). The curriculum is expected to describe a vision of school mathematics in which these purposes are embedded in a context that is both broader and more consistent with accelerating changes in today's society. Since the publication of *A Nation At Risk*, in 1983, high school mathematics curricula have been a continuous focus of the education reform movement.

It has been argued that achievement in mathematics and later academic success differ between Whites and Asian Americans on the one hand and African Americans and Hispanics on the other (Secada, 1989). The disparities in mathematics education in the United States have been described as evidence of deep structural defects in the system on how mathematics is learned and taught (Oakes, 1990a, 1990b; Secada, 1989; Secada & Meyer, 1991).

Because of the disparities in educational opportunities in mathematics, a study to assess what factors influence performances on standardized mathematics tests is timely. Some of these factors may include teaching practices, students' attitudes toward mathematics, gender, location of schools, students' perceptions of mathematics and time spent doing

homework assignments, and changes in socioeconomic and demographic characteristics.

The objective of the present study is to find out whether scores on standardized mathematics tests are influenced by (1) students' perceptions, attitudes, time invested in school work, and their socioeconomic characteristics; (2) perceptions regarding teachers, their reported relationships with students, and teaching practices; (3) selected characteristics of schools; and (4) parents' involvement. Figure 1 illustrates the main conceptual framework of the study.

******** FIGURE 1 ABOUT HERE ********

Method

Sample

Data for the study are the survey results of the 1988 National Educational Longitudinal Study of Eighth Graders (NELS-88). Of the 22,497 participants in the survey, 49.6% were females and 50.4% were males. The ethnic composition was as follows: 14.1% Hispanics, 13.4% African Americans, and 72.5% Caucasians. For this study, 3,000 students were randomly selected from each ethnic group in public schools.

Variables

The data set included a variety of variables such as student's self-perception, perceptions of teachers, school, and parents. Several composite variables were constructed from single indicators in the data set. Factor analysis was used to form these composite scores. A summary of items are presented in

Table 1.

******** INSERT TABLE 1 ABOUT HERE ********

The Theoretical Model

A multiple regression model is used to estimate the parameters for the selected explanatory variables and constructs outlined in the objectives. The model is expressed as:

$$Y = ß_0 + ß_1(STUCHAR)_1 + ß_2(TEACHER)_2 + ß_3(SCHOOL)_3 + ß_4(PARENT)_4 + \varepsilon$$

The dependent variable Y, was the score on the mathematics standard test. These scores are reported for students in the NELS-88 data (see Ingles *et al*, 1992). Four predictor variables were used in the study. These variables are explained in Table 1. The ß terms are the unknown parameters to be estimated. The ε term is the independent random variable assumed to be normally distributed with mean 0 and variance σ^2. The model was estimated by the SPSS software program.

Results and Discussion

Results from three multiple regression analyses are discussed here. Table 2 presents the results of multiple regression analysis in the sample. This model explains 39% of the variation in math achievement [R^2 (adjusted)=.39, $p<.01$]. Ten of the sixteen variables are statistically significant predictors of math achievement. The results suggest that the composite of self-concept, post-secondary education plans, the ability to talk to counselors/teachers, student's math perceptions, and academic climate at these schools are positively related to scores earned. Performance is inversely related to

race, student's perception of curriculum, the percentage of minority students enrolled in a particular school, and student's attitude towards math. Performance is affected negatively by students' ability, whether they have algebra at least once per week and looked forward to mathematics classes, and their perceptions of the usefulness of mathematics in the future.

******** INSERT TABLE 2 ABOUT HERE ********

Table 3 presents results from a second multiple regression analysis contained only African-American students. Isolating African-Americans in this model explains 20% of the variation [R2= .20, p<.05]. The strongest positive predictor among the African-American students is self-confidence and self-esteem (Beta=.193); the weakest predictor is school climate. Thus, if students experience minor disruptions in their classes, then performance levels on mathematics standardized tests are high. Students' attending regular mathematics class at least once a per week and doing their homework seem to have a positive influence on performance on mathematics standardized tests. Performance is negatively related to student's mathematics perception. Thus, when students think that math will not be useful in their future and they dislike math, then performance levels on mathematics standardized tests are low.

******** INSERT TABLE 3 ABOUT HERE ********

Table 4 presents the final regression analysis for Caucasian students. This model explains 34% of the variation for Caucasian students' performance on mathematics standardized tests [R2=.34,

p<.05]. The strongest positive predictor for Caucasian students is post-secondary education plans (Beta=.321). In addition, students' self confidence and self esteem (Beta=.152) have positive influences on performance on mathematics standardized tests. The ability to talk to counselors and teachers about personal problems, number of hours spent on mathematics homework, hours spent on homework in general, and students' attending regular mathematics class at least once a per week, also have a positive influence on performance on mathematics standardized tests. Performance is affected negatively by students' mathematics perception, attitude towards math, and percentage of minority in school.

******** INSERT TABLE 4 ABOUT HERE ********

With respect to the actual teaching of students, the results show no statistical significance between performance and students' perceptions of whether: the teaching is good, teachers are interested in them, their efforts are praised, or if they are intimated by teachers. If students perceived that the teaching is bad or that teachers are not interested in them, then a negative relationship is shown between these views and performance level. The results also suggest that the lack of praises by teachers would not necessarily affect performance. In fact, the results show that scores on mathematics standardized tests are positively related to little or no praise from teachers.

In terms of parents characteristics, positive relationships

seem to exist between performance and the frequency with which parents checked homework assignments.

Summary and Conclusion

The study explored whether school climate, teacher, student and parent characteristics have any effect on students' performances on mathematics standardized tests. The results support the view that minority groups, in particular African-Americans perform poorly on standardized tests. The results also suggest that an inverse relationship exists between the performance by African-Americans and the scores earned on standardized mathematics tests. Several characteristics besides race are statistically significant in the model. If students are enrolled in public schools and have little or no disruptions in the classroom, then these factors relate positively with performance. The amount of time spent on mathematics homework, the ability to talk to teachers and counselors about personal problems, time spent on homework assignments in general, attending regular mathematics classes at least once per week, and love of mathematics, appear to have positive relationships with performance. Students' perceptions of teachers' ability and care are also shown to vary inversely with performance. If students perceive that the teaching is poor and that teachers are indifferent, then performance suffered. On the other hand, if students are not intimidated by teachers, the results suggest that performance would improve. Performance does not appear to

be too closely linked to whether students are praised by teachers.

The following conclusion is drawn from the study: (1) performance on standardized tests and, perhaps, in school overall curricula is deeply intertwined in a network of players--school, students and teachers. Based on the study, it appears that the students' mathematics perceptions seem to be the major factor affecting the overall performance on mathematics standardized tests. Furthermore, performance levels still vary among ethnic groups. In general, African-Americans performed below Caucasians. Although it will be difficult to address the socioeconomic issues in the short run, findings from this sample may be useful in shaping policy regarding school reform.

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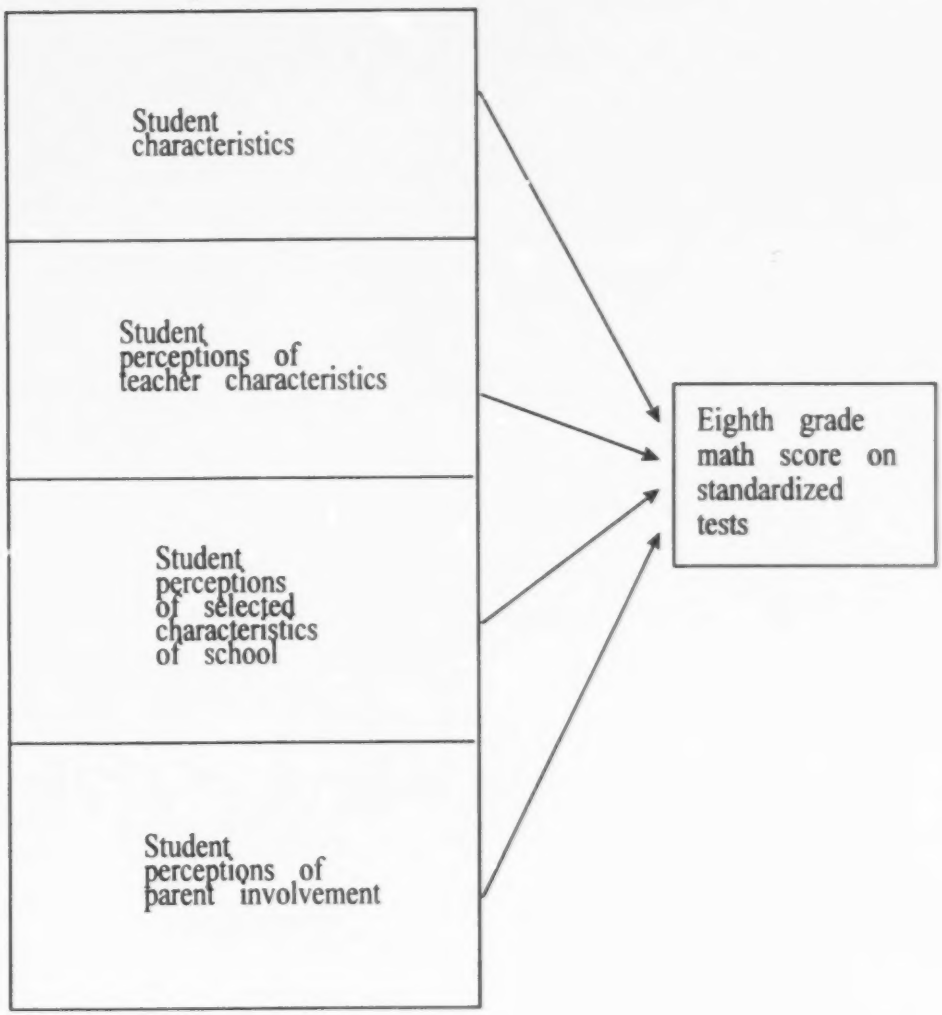
Student characteristics
Student perceptions of teacher characteristics
Student perceptions of selected characteristics of school
Student perceptions of parent involvement
Eighth grade math score on standardized tests

Figure 1 Indicators that may Influence eighth grade students' scores on Standardized Mathematics Tests.

Table 1. Factor Blocks, Variable Definitions and Codes for the Survey Data.

Variables	Definitions & Codes
	STUDENT CHARACTERISTICS
MATHUSIF	Math will be useful in my future. Strongly agree/agree=0, disagree/strongly disagree=1.
LFMATHCL	Usually look forward to math class. Strongly agree/agree=0, disagree/strongly disagree=1.
SEFCONT2	Is the second self-concept items in student's question.
SEFCONT1	Is the first self-concept items in student's question.
ARMATHCL	Attend regular math at least once a week. Attend=1, do not attend=2.
AAMATHCL	Attend algebra at least once a week. Attend=1, do not attend=2.
HRHOMEWK	Number of hours spent on homework per week. None-5.49=0, >5.50=1, else=98.
POSEDPLN	Post secondary education plans.
CLWOHMWK	How often come to class without homework.
TMATHHMW	Time spent on math homework each week. None=0, <1 hour to 2 hours=1, >3 hours=2.
TALKCONS	Talk to counselor about studies in class. Yes=1, No=2.
TALKCONP	Talk to counselor about personal problems. Yes=1, No=2.
TALKTCHP	Talk to teacher about personal problems. Yes=1, No=2.
ATTITUD1	I feel good about myself. Strongly agree/agree=0, disagree/strongly disagree=1.
MATHHWK1	Students' mathematics perceptions. High/middle=0, low=1, not grouped/don't know/else=8.
MATHHPL1	Students' perceptions of curriculum.
TALKTO1	Students' motivations to talk to adults.
	TEACHER
PRCPTCH1	Students' perceptions of teacher. Strongly agree/agree=0, disagree/strongly disagree=1.

Table 1. Factor Blocks, Variable Definitions and Codes for the Survey Data.

Variables	Definitions & Codes
	SCHOOL
CLIMATE1	Students' perceptions of school climate. Strongly agree/agree=0, disagree/strongly disagree=1.
OTHSDISP	Other students often disrupt class. Strongly agree/agree=0, disagree/strongly disagree=1.
FELNOSAF	I don't feel safe at this school. Strongly agree/agree=0, disagree/strongly disagree=1.
MISBEHAV	Misbehaving students often get away with it. Strongly agree/agree=0, disagree/strongly disagree=1.
DISRUPTL	Student disruptions inhibit learning. Strongly agree/agree=0, disagree/strongly disagree=1.
URBANICI	Urbanicity of the student's school. Urban=1: suburban/rural=2: else=3.
PBSCHOOL	School control composite. Public=0, Others=1.
PERMINOR	Percentage of minority students. None/1.5-30%=0: 31-100%=1.
	PARENT
PARENT11	Students' perceptions of parents.
PARTKTCH	Parents spoke to teacher/counselor. Yes=1, No=2.
PARASCHM	Parents attend a school meeting. Yes=1, No=2.
PARCKHWK	How often parents check on students' homework. Often/sometimes=0, rarely/never=1.
SEX	Male=1, Female=2.
RACE	Caucasian=4, African-American=3, Hispanic=2.
RACESEX	Race and sex of student.
	DEPENDENT VARIABLE
MATHSCRE	Standardized mathematics score.

Table 2. Results of Regression analysis predicting Mathematics Achievement in the Total Sample.

				Final Model	
Step	Variables	R	R^2	B	Beta
1	ATTITUD1	.046	.002	-.596	-.058*
2	SEFCONT2			2.361	.155*
	SEFCONT1	.162	.026	-1.836	-.138*
3	MATHHPL1	.381	.146	-2.988	-.267*
4	MATHHWK1	.410	.168	.680	.065*
5	POSEDPLN	.470	.221	1.819	.237*
6	CLWOHMWK	.470	.221	.293	.040
7	TALKTO1	.495	.245	1.078	.105*
8	PRCPTCH1	.495	.245	-.068	-.007
9	CLIMATE1	.508	.253	.439	.043*
10	URBANICI			-.084	-.007
11	PERMINOR	.580	.337	-.425	-.096*
12	FEMALE			-.443	-.022
	BLACK	.623	.388	-6.303	-.319*
13	RACESEX	.623	.388	.224	.010
14	PARENT11			.262	.026

R^2 (adjusted) is 0.386 and F-value 192.052
* p<.05

Table 3. Results of Regression analysis predicting Mathematics Achievement among African-American students.

				Final Model	
Step	**Variables**	**R**	**R^2**	**B**	**Beta**
1	ATTITUD1	.086	.007	-.361	-.041
2	SEFCONT2			2.528	.193*
	SEFCONT1	.204	.042	-1.536	-.133*
3	MATHHPL1	.354	.125	-2.569	-.255*
4	MATHHWK1	.372	.138	.727	.083*
5	POSEDPLN	.410	.168	1.108	.175*
6	CLWOHMWK	.410	.168	.115	.018
7	TALKTO1	.426	.182	.868	.113*
8	PRCPTCH1	.426	.182	-.048	-.006
9	CLIMATE1	.430	.185	.366	.045*
10	URBANICI			-.141	-.015
11	PERMINOR	.448	.201	-.688	-.131*
12	FEMALE			-.059	-.004
13	PARENT11			.261	.030

R^2 (adjusted) is 0.197 and F-value 43.470
* $p<.05$

Table 4. Results of Regression analysis predicting Mathematics Achievement among Caucasian students.

				Final Model	
Step	Variables	R	R^2	B	Beta
1	ATTITUD1	.173	.030	-.806	-.080*
2	SEFCONT2			2.261	.152*
	SEFCONT1	.242	.058	-2.125	-.163*
3	MATHHPL1	.450	.203	-3.183	-.306*
4	MATHHWK1	.476	.227	.577	.057*
5	POSEDPLN	.562	.316	2.455	.321*
6	CLWOHMWK	.563	.317	.385	.056*
7	TALKTO1	.578	.335	1.454	.125*
8	PRCPTCH1	.579	.335	-.123	-.012
9	CLIMATE1	.581	.338	.530	.050*
10	URBANICI			-.225	-.016
11	PERMINOR	.583	.340	-.297	-.051*
12	FEMALE			-.596	-.030
13	PARENT11			.223	.023

R^2 (adjusted) is 0.337 and F-value 89.103
* $p<.05$